Active over 45: a step-up jogging programme for inactive female hospital staff members aged 45+

Baschung Pfister, Pierrette ; Niedermann, Karin ; Sidelnikov, Eduard ; Bischoff-Ferrari, Heike A

Abstract: BACKGROUND: Inactive individuals face motivational obstacles for becoming and remaining physically active. Therefore, sustainable physical activity promotion programmes tailored to reach inactive individuals are needed. The aim of this study was to test the role of motivation and the effect and feasibility of a training programme. METHODS: We enrolled physically inactive female hospital staff members aged 45 and older in an uncontrolled exercise trial. Follow-up assessments were at 3 and 12 months. The primary outcome was running distance (Cooper test). Secondary outcomes were level of physical activity (Freiburger Physical Activity Questionnaire) and body mass index. RESULTS: Out of 1249 female hospital staff, 275 classified themselves as inactive and 250 (91%) of them were interested in the exercise programme. Of these, 68 (27%; mean age 53.2 years) agreed to participate in our study and 47 (69%) completed the programme. Average running distance increased by 255.70 m [95% confidence interval (CI) 208.09-303.31] at 3-month follow-up with a sustained benefit at 12-month follow-up (194.02; 95% CI 143.75-244.47). Physical activity level increased by 1152.52 kcal week(-1) (95% CI 703.73-1601.32) at 3 months with a sustained benefit (1279.10 kcal week(-1), 95% CI 826.80-1731.40) after 12 months. Notably, baseline motivation to become physically active was not associated with change in physical performance or physical activity level during the programme. CONCLUSION: The 3-month step-up jogging programme is a feasible and effective exercise intervention for physically inactive, middle-aged female hospital staff members. The intervention leads to sustained benefits independently of motivation to become more physically active.

DOI: https://doi.org/10.1093/eurpub/ckt027

European Journal of Public Health, Vol. 23, No. 5, 817–822

doi:10.1093/eurpub/ckt027 Advance Access published on 14 March 2013

Active over 45: a step-up jogging programme for inactive female hospital staff members aged 45+

Pierrette Baschung Pfister[1,2], Karin Niedermann[2], Eduard Sidelnikov[3], Heike A. Bischoff-Ferrari[3,4]

1 Physiotherapy and Occupational Therapy Research, Direction Research and Education, University Hospital Zurich, Zurich, Switzerland
2 Department of Health, Institute of Physiotherapy, Zurich University of Applied Sciences, Winterthur, Switzerland
3 Centre on Aging and Mobility, University of Zurich and City Hosptial Waid, Zurich, Switzerland
4 Department of Rheumatology, University Hospital Zurich, Zurich, Switzerland

Correspondence: Pierrette Baschung Pfister, Institute for Physical Medicine, Gloriastrasse 25, 8091 Zürich, Switzerland, Tel: +41 44 255 2491, Fax: +41 44 255 4388, e-mail: pierrette.baschung@usz.ch

Background: Inactive individuals face motivational obstacles for becoming and remaining physically active. Therefore, sustainable physical activity promotion programmes tailored to reach inactive individuals are needed. The aim of this study was to test the role of motivation and the effect and feasibility of a training programme. **Methods:** We enrolled physically inactive female hospital staff members aged 45 and older in an uncontrolled exercise trial. Follow-up assessments were at 3 and 12 months. The primary outcome was running distance (Cooper test). Secondary outcomes were level of physical activity (Freiburger Physical Activity Questionnaire) and body mass index. **Results:** Out of 1249 female hospital staff, 275 classified themselves as inactive and 250 (91%) of them were interested in the exercise programme. Of these, 68 (27%; mean age 53.2 years) agreed to participate in our study and 47 (69%) completed the programme. Average running distance increased by 255.70 m [95% confidence interval (CI) 208.09–303.31] at 3-month follow-up with a sustained benefit at 12-month follow-up (194.02; 95% CI 143.75–244.47). Physical activity level increased by 1152.52 kcal week^{-1} (95% CI 703.73–1601.32) at 3 months with a sustained benefit (1279.10 kcal week^{-1}, 95% CI 826.80–1731.40) after 12 months. Notably, baseline motivation to become physically active was not associated with change in physical performance or physical activity level during the programme. **Conclusion:** The 3-month step-up jogging programme is a feasible and effective exercise intervention for physically inactive, middle-aged female hospital staff members. The intervention leads to sustained benefits independently of motivation to become more physically active.

Introduction

Physical inactivity is a major public health problem contributing to growing incidence of cardiovascular disease,[1] type 2 diabetes,[2] hypertension,[3] osteoporosis[4] and cancer.[5] Benefits of physical activity are well established and extend from prevention of chronic diseases to better mental health and possible economic benefits such as fewer physician visits and hospitalizations, shorter hospital stays and less absence from work.[6] Notably, increased physical activity always provides health benefits, but they are most pronounced among inactive individuals.[7,8]

The current minimum recommendations for healthy adults are 30 min of moderate aerobic exercise 5 days a week or 20 min of vigorous exercise 3 days a week.[6,9] Combinations of the two regimens are encouraged. More than 50% of American adults[10] and two-thirds of Europeans[6,9] do not reach these levels of physical activity and, therefore, are classified as physically inactive. Prevalence of inactivity may be somewhat higher in women than in men, and it steadily increases with age regardless of sex.[11] Inactivity is also common among hospital employees. About 60% of all women in the Nurses' Health Study[12] and more than 50% of all health professionals in the Women's Health Study[13] were classified as insufficiently active (spending less than 10.5 MET-hours or 1000 kcal per week on physical activity).

Earlier research has shown that an intervention aiming at long-term adherence to physical activity programmes in women more than 45 years has to satisfy several important criteria: convenient location, financial feasibility, adequate duration and provision of social support and integration.[14] The World Health Organization recommends the workplace as one of the settings for health promotion.[15] However, although the workplace setting meets key criteria that facilitate participation in a training programme, previous studies in this setting reported mixed results suggesting benefits in some studies[16–18] but not in others.[19,20] Among the most difficult obstacles that a person has to overcome on the way to become more physically active are lack of motivation and necessity to change habitual physical activity patterns which proves to be very difficult.[21]

In order for a physical activity programme to sustain long-term adherence, it should facilitate participant's progression towards the Maintenance stage of the target behaviour where new behaviour patterns become fully internalized.

The aim of the study was to measure participants' motivation to become more physically active and to test the effect of a 3-month step-up jogging programme on endurance and physical activity level of these women with respect to short-term (3-month) and sustained benefits (12 months).

Methods

Participants

Participants were recruited among female staff members of the University Hospital in Zurich, Switzerland, using a two-stage recruitment procedure (figure 1). Totally, 4090 female employees worked at the University Hospital Zurich and 1249 of them were older than 45 years. Most of the women worked as healthcare practitioners or technician: 50% were nurses, 10% were medical doctors

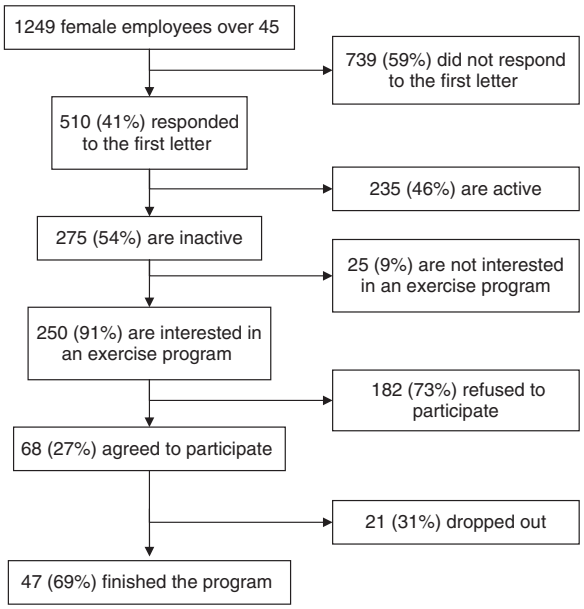

Figure 1 Sample selection strategy

or scientists and 25% were other health professionals (e.g. physical therapists, laboratory technician). Remaining women worked in the administration (10%) and home economics or technical service (5%).

First, we contacted all 1249 female employees aged 45 and older with a letter asking about their level of physical activity, their motivation to become more active and willingness to participate in a physical exercise programme. All women were encouraged to respond. The level of physical activity and the motivation to improve physical activity was assessed with four screening questions.[22] At the second stage of recruitment, only women who were classified as inactive were invited to participate in our training programme. Those who agreed to participate were screened according to the inclusion criteria for the study. Women who had an osteoporotic fracture in the past 3 months, or any other significant musculoskeletal, cardiac or respiratory disorder were excluded from the study.

Intervention

All women enrolled in the study participated in a 3-month step-up jogging training administered by physical therapists twice a week. The aim of the programme was to train the participants to run 5 km without rest. Very dedicated women were given the possibility to join a national women's run. Each training session included a practical and a theoretical part.

The step-up jogging training was specifically designed for inactive women. Since beginners are usually out of breath after only a few minutes of running, regular walking recovery breaks were integrated into the programme. During the first session the participants walked for 1 min after each 2 min of running. Thereafter, the running intervals have been progressively increased each week from 2 to 20 min with 1-min walking interval between them. Finally, in weeks 11 and 12 participants had to run continuously for 35 and 40 min, respectively (figure 2).

Within the theoretical part of each session, the participants were given motivational flyers about exercise, behaviour modification and health.

Motivation level according to the Transtheoretical Model

The motivation to change health behaviour is described by the Transtheoretical Model. In relation to physical activity it postulates that inactive individuals engaging in a new behaviour move through different stages: low level of motivation (Precontemplation), medium level of motivation (Contemplation) and high level of motivation (Preparation). Individuals who are engaged in the desired behaviour are at the stage of Action (exercise regularly) or Maintenance (exercise regularly for more than 6 months).[23]

Outcomes and Follow-up

Physical performance

Physical performance of the participants was measured by the Cooper test that was carried out indoors on a pre-defined 80-m course.[24] Participants were asked to cover as much distance as they could in 12 min by walking or running as long as their heart rate did not exceed the estimated maximal heart rate (220—age). Participants used a heart rate monitor (Polar Electro Oy) during the test to control their heart rate.

Level of physical activity

Freiburger Physical Activity Questionnaire was used to assess level of physical activity.[25] This questionnaire includes activities of daily life such as commuting or gardening, sport activities and leisure-time activities such as dancing or bowling. To calculate energy expenditure, the duration of each activity was converted into hours per week and then multiplied by the corresponding metabolic equivalent value[26] and the participant's body weight. Weekly energy expenditure was then calculated as a sum of energy expenditures for all activities during the week.

We measured height and weight of each participant to calculate their body mass index (BMI, $kg\,m^{-2}$).

Physical performance, level of physical activity and BMI were assessed at baseline, at the end of the intervention period (3 months) and at the end of the follow-up (12 months).

Statistical analysis

Baseline characteristics of the study participants by level of motivation were compared using one-way analysis of variance; participation and dropout rates by level of motivation were compared by the chi-square test. The effects of the intervention on physical performance, energy expenditure and BMI at 3- and 12-month follow-up were compared by linear mixed models. Each model controlled for the level of motivation, age and BMI at baseline. All statistical analyses were performed using SAS 9.2 statistical software (Copyright© 2002-2008 by SAS Institute Inc., Cary, NC, USA). A P-value of <0.05 for a two-sided test was considered statistically significant for all estimates.

Results

Of 1249 contacted female employees of Zurich University Hospital, 510 (41%) responded. Among these, 235 (46%) classified themselves as physically active (stage Action or Maintenance) and were, therefore, excluded. Of the 275 women who qualified themselves as physically inactive, 250 (91%) expressed interest in the training programme. Of 68 (27.2% of those interested) women who agreed to participate, 47 (69%) completed the entire programme and 21 (31%) dropped out for the following reasons: poor health ($n=12$), lack of time ($n=6$), conflicting job ($n=1$) and unknown reason ($n=2$; figure 1).

Most of the participants worked as healthcare practitioners or technicians: nurses (34%), medical doctors or scientists (6%) or other healthcare professionals (51%). Seven per cent worked in administration and the remaining 2% in home economics or technical service.

week 1	8 x (2 minutes jogging, 1 minute brisk walking), total 23 minutes plus stretching
week 2	7 x (3 minutes jogging, 1 minute brisk walking), total 27 minutes plus stretching
week 3	6 x (4 minutes jogging, 1 minute brisk walking), total 29 minutes plus stretching
week 4	5 x (5 minutes jogging, 1 minute brisk walking), total 29 minutes plus stretching
week 5	4 x (7 minutes jogging, 1 minute brisk walking), total 31 minutes plus stretching
week 6	3 x (10 minutes jogging, 1 minute brisk walking), total 32 minutes plus stretching
week 7	3 x (10 minutes jogging, 1 minute brisk walking), total 32 minutes plus stretching
week 8	3 x (12 minutes jogging, 1 minute brisk walking), total 38 minutes plus stretching
week 9	2 x (15 minutes jogging, 1 minute brisk walking), total 31 minutes plus stretching
week 10	2 x (20 minutes jogging, 1 minute brisk walking), total 41 minutes plus stretching
week 11	35 minutes jogging plus stretching
week 12	40 minutes jogging plus stretching

Figure 2 Step up jogging programme

Table 1 Baseline characteristics of study participants[a]

Characteristics	All ($N = 68$)	Participants with low level of motivation ($N = 8$)	Participants with medium level of motivation ($N = 20$)	Participants with high level of motivation ($N = 40$)	*P*-value (one-way analysis of variance)
Age (years)	53.15 (4.24)	53.12 (5.54)	52.35 (4.03)	53.55 (4.12)	0.59
Height (m)	1.64 (0.06)[b]	1.62 (0.05)[c]	1.65 (0.05)[d]	1.63 (0.06)[e]	0.60
Weight (kg)	62.28 (9.06)[f]	57.17 (5.3)[c]	62.46 (7.82)[d]	62.74 (9.96)[g]	0.61
BMI (kg m^{-2})	23.28 (3.05)[f]	21.91 (3.34)[c]	22.96 (2.59)[d]	23.59 (3.28)[g]	0.61
Cooper test (m)	1492.76 (175.97)	1455.86 (169.31)	1518.00 (144.11)[d]	1487.53 (193.12)[e]	0.68
Weekly energy expenditure (kcal week^{-1})	909.98 (559.94)[d]	505.17 (173.52)[h]	926.28 (499.33)[h]	966.18 (606.90)[h]	0.17

[a]Values are given as mean (SD).
[b]Twenty-one values are missing.
[c]Five values are missing.
[d]Six values are missing.
[e]Ten values are missing.
[f]Twenty-three values are missing.
[g]Twelve values are missing.
[h]Two values are missing.

Baseline characteristics of the study participants are presented in table 1.

Participants in the different levels of motivation did not differ significantly with respect to age, height, weight, BMI, physical performance level and weekly energy expenditure. Average baseline energy expenditure for the entire study population was 910 kcal week^{-1} [standard deviation (SD) = 560] and the mean baseline running distance on the Cooper test was 1493 m (SD = 176). These results indicate inactive lifestyle (<1500 kcal week^{-1}) and low level of physical performance (<1600 m on the Cooper test). Those at low level of motivation on average tended to have the lowest weight, level of physical performance and weekly energy expenditure; women at a medium level of motivation tended to be the heaviest and spent the most energy during the week, whereas participants at a high level of motivation had the highest level of physical performance.

After the 3-month training programme, the average running distance increased by 255.70 m [95% confidence interval (CI) 208.09–303.31] compared with baseline. The effect of the programme was still significant at the end of the 12-month follow-up: the participants covered on average 194.02 m (95% CI 143.75–244.47) more distance compared with baseline.

Average level of physical activity increased by 1152.52 kcal week^{-1} (95% CI 703.73–1601.32) at 3 months and by 1279.10 kcal week^{-1}

Table 2 Differences in physical activity, Cooper test and BMI at baseline, 3 and 12 months[a]

Parameter, mean (SE)	Baseline ($N=47$)	3 months ($N=47$)	12 months ($N=46$)	Difference (3 month − baseline)	*P*-value	Difference (12 month − baseline)	*P*-value
Cooper test (m)	1471.93 (43.58)	1727.63 (43.59)	1665.95 (44.19)	255.70 (23.88)[b]	<0.0001	194.02 (25.31)	<0.0001
Weekly energy expenditure (kcal week^{-1})	843.44 (263.16)	1995.96 (263.16)	2122.54 (264.09)	1152.52 (225.38)	<0.0001	1279.10 (227.15)	<0.0001
BMI (kg m^{-2})	23.18 (0.68)[c]	22.94 (0.68)[c]	23.09 (0.68)	−24 (0.14)[d]	0.08	−0.09 (0.14)	0.50

[a]Values are adjusted mean (SE) for each variable. All analysis control for age and BMI at baseline.
[b]Six observations are missing.
[c]One observation is missing.
[d]Two observations are missing.
N = sample size.

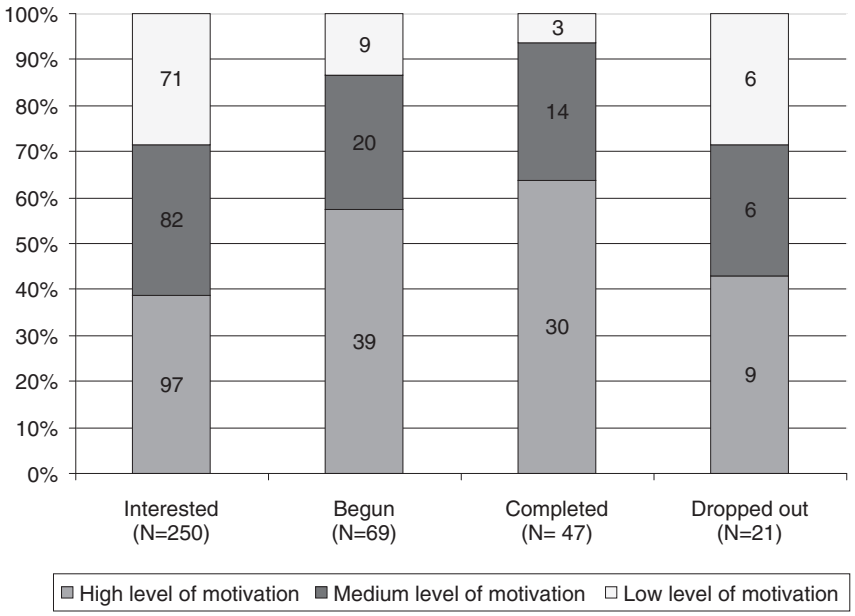

Figure 3 Proportions of participants that were interested, began and completed the programme by level of motivation

(95% CI 826.80–1731.40) at the end of the 12-month follow-up compared with baseline. There was no significant change in BMI over the follow-up period (table 2).

Baseline motivation level was not associated with change in physical performance or physical activity level during the programme. However, having higher level of motivation increased the likelihood for the participant to be enrolled in the study ($P<0.001$). The 250 inactive women who expressed interest in the study classified themselves into the following levels of motivation: high level: $n=97$ (39%), medium level: $n=82$ (33%) and low level: $n=71$ (28%). Only 13% of the interested women with low motivation started the programme. This percentage went up to 24% in moderately motivated women and up to 40% in highly motivated women. Adherence to the programme also appeared to be associated with motivation level with borderline statistical significance ($P=0.05$). The proportion of adherent women was the highest (77%) among women in the high motivation level group, 70% in the moderately motivated women and 33% in the women with low motivation (figure 3).

The compliance to the programme was good: on average the participants attended 80% of all training sessions (range, 50–100%).

Women who dropped out of the programme had significantly lower average weekly energy expenditure at baseline compared with those who completed the intervention (520.40 and 1034.32 kcal week^{-1} respectively, $P<0.001$). Dropouts were not significantly different from those who completed the programme with respect to baseline age, BMI and physical performance.

Discussion

Our training programme significantly increased running distance and total level of physical activity in inactive female hospital staff members aged 45 and older. Notably, the increase in running distance and level of physical activity documented after the 3-month intervention was largely sustained at the 12-month follow-up. This suggests that the women who participated in the programme were able to maintain higher level of physical activity beyond the instructed intervention period. Notably, while baseline motivation to become more active had no impact on the results of the intervention, it was a significant predictor of participation in the programme and adherence to it.

Our findings contribute to the literature of the beneficial effect of exercise on fitness and improvement in physical activity. Asikainen *et al.* reviewed 18 studies among a total of 1488 participants that investigated the effect of exercise on cardiorespiratory fitness in early post-menopausal women. Seventeen out of the 18 studies reported improvement of maximal aerobic power[27]; seven of the studies[28–34] used walking/jogging interventions that were similar to the one used in our study.

Determinants of sustained benefits after short-term exercise interventions have not been studied conclusively.[35] While long-term benefits after 12 months of a group-based intervention are supported by one study,[36] other studies reported no long-term benefits.[37,38] Our study and the other positive study by King *et al.*[36] recruited middle-aged adults, and both studies applied a relatively intense and well-supervised exercise programme. In contrast, no long-term benefits after an instructed exercise programme were reported by two studies: one was done among students, a much younger population,[37] and another used a less defined and supervised intervention which simply advised to join a local health walk programme.[38]

An alternative explanation of the sustained benefit observed in our study is that the participants knew each other before the programme, wanted to join the programme together and motivated each other during the programme. This may have provided a group effect even beyond the end of the intervention. There is evidence that social support interventions in community settings—for example a workplace—are effective in increasing levels of physical activity.[39]

In our study, a higher baseline self-motivation towards physical activity was associated with increased likelihood of participating in the offered exercise programme ($P < 0.001$). Two hundred fifty physically inactive women expressed their interest to participate in the study. However, only about a quarter of these have actually joined the exercise programme. This relatively low participation rate may in part be explained by the concept of motivational stage as larger percentage of women who were classified as highly motivated enrolled in the trial. Alternatively, the rate of participation could have been improved by offering a greater choice of alternative exercise strategies. Some of the women who were motivated to increase their physical activity but did not participate in the programme commented that they thought jogging was too intense and would prefer walking or dancing instead.

People with moderate or high motivation levels were also more likely to adhere to the programme compared with those with low motivation levels at baseline. This association only approached significance ($P = 0.05$), but was consistent with findings of other studies which reported that motivation was significantly associated with adherence to physical exercise programmes.[40,41] Based on our results, motivation is a key determinant of participation and adherence, although the fitness effect of the training is not affected by motivation. Women who had low motivation to begin the programme experienced the highest dropout rate, but those of them who stayed in the programme had good results. This suggests that physical activity programmes should include motivational strategies to keep such participants in. Motivational strategies include addressing facilitators and barriers, supporting emotional and cognitive change processes or promoting self-efficacy.

Our study has several strengths. We used a two-stage recruiting procedure that was successful in reaching inactive women. Our professionally administered training programme proved to be feasible and resulted in participants maintaining their increased running distance and physical activity beyond the 3-month intervention phase.

The main limitation of the study is the lack of a control group and the 30% dropout rate during the exercise programme. Our dropout rate, although sizeable, is comparable to the rates reported in the literature for similar trials.[42] Many studies indicate that more than 50% of those who adopt a physical activity programme will discontinue participation within 3–6 months.[43,44] As a next step, our data may serve as pilot data to a randomized controlled trial.

In summary, our study shows that it is possible to reach inactive women more than 45 years with a workplace-based physical activity promotion programme. Further, our data suggest that the benefits of such a programme are sustained beyond its termination.

Immediate and long-term effects of the physical activity programme should be further studied in a randomized trial setting.

Conflicts of interest: None declared.

Key points

- Sedentary lifestyle is a major public health problem and benefits of of physical activity are most pronounced among inactive individuals.
- Therefore, physical activity promotion programmes should be tailored to reach inactive individuals.
- Our two-stage recruitement procedure was succesfull in reaching inactive women.
- A 12-week step-up jogging programme increased running distance and total level of physical activity in inactive female hospital staff member aged 45 and older.
- The increase in running distance and total level of physical activity was largely sustained at the 12-month follow-up.
- Immediate and long-term effect of this programme should be further studied in a randomized trial setting.

References

1 Bassuk SS, Manson JE. Physical activity and the prevention of cardiovascular disease. *Curr Atheroscler Rep* 2003;5:299–307.

2 Hu G, Qiao Q, Silventoinen K, et al. Occupational, commuting, and leisure-time physical activity in relation to risk for Type 2 diabetes in middle-aged Finnish men and women. *Diabetologia* 2003;46:322–9.

3 Pescatello LS, Franklin BA, Fagard R, et al. American College of Sports Medicine position stand. Exercise and hypertension. *Med Sci Sports Exerc* 2004;36:533–53.

4 Howe TE, Shea B, Dawson LJ, et al. Exercise for preventing and treating osteoporosis in postmenopausal women. *Cochrane Database Syst Rev* 2011;CD000333.

5 Kushi LH, Byers T, Doyle C, et al. American Cancer Society Guidelines on Nutrition and Physical Activity for cancer prevention: reducing the risk of cancer with healthy food choices and physical activity. *CA Cancer J Clin* 2006;56:254–81. quiz 313–4.

6 Bundesamt für Sport BASPO. Gesundheitswirksame Bewegung. Available at: http://www.baspo.admin.ch/internet/baspo/de/home/themen/foerderung/breitensport/gesundheit/empfehlungen/fuer_erwachsene.parsys.0003.downloadList.27082.DownloadFile.tmp/grundlagendokuhepa2009de.pdf.pdf (28 November 2012, date last accessed).

7 Lollgen H, Bockenhoff A, Knapp G. Physical activity and all-cause mortality: an updated meta-analysis with different intensity categories. *Int J Sports Med* 2009;30:213–24.

8 Warburton DE, Charlesworth S, Ivey A, et al. A systematic review of the evidence for Canada's Physical Activity Guidelines for Adults. *Int J Behav Nutr Phys Act* 2010;7:39.

9 World Health Organization. Physical activity and health in Europe: evidence for action. Available at: http://www.euro.who.int/__data/assets/pdf_file/0011/87545/E89490.pdf (28 November 2012, date last accessed).

10 Centers for Disease Control and Prevention. Adult participation in recommended levels of physical activity: United States, 2001 and 2003. *MMWR* 2005;54:1208–12.

11 U.S. Department of Health and Human Services. Physical Activity Guidelines Advisory Committee Report, 2008. Available at: http://www.health.gov/paguidelines/report/ (28 November 2012, date last accessed).

12 Manson JE, Hu FB, Rich-Edwards JW, et al. A prospective study of walking as compared with vigorous exercise in the prevention of coronary heart disease in women. *N Engl J Med* 1999;341:650–8.

13 Lee IM, Rexrode KM, Cook NR, et al. Physical activity and coronary heart disease in women: is "no pain, no gain" passe? *JAMA* 2001;285:1447–54.

14 Lamprecht M, Stamm H. *Sport in der zweiten Lebenshälfte, Analysen zum Seniorensport in der Schweiz. Sekundäranalyse der SOV-STG-Studie "Sport Schweiz 2000"*. New York: Bundesamt für Sport, 2001.

15 World Health Organisation. Preventing noncommunicable diseases in the workplace through diet and physical activity. Available at: http://whqlibdoc.who.int/publications/2008/9789241596329_eng.pdf (28 November 2012, date last accessed).

16 Chan CB, Ryan DA, Tudor-Locke C. Health benefits of a pedometer-based physical activity intervention in sedentary workers. *Prev Med* 2004;39:1215–22.

17 Proper KI, Hildebrandt VH, Van der Beek AJ, et al. Effect of individual counseling on physical activity fitness and health—a randomized controlled trial in a workplace setting. *Am J Prev Med* 2003;24:218–26.

18 Dishman RK, DeJoy DM, Wilson MG, Vandenberg RJ. Move to improve a randomized workplace trial to increase physical activity. *Am J Prev Med* 2009;36: 133–41.

19 Marcus BH, Williams DM, Dubbert PM, et al. Physical activity intervention studies—what we know and what we need to know—a scientific statement from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity); Council on Cardiovascular Disease in the Young; and the Interdisciplinary Working Group on Quality of Care and Outcomes Research. *Circulation* 2006;114:2739–52.

20 Dishman RK, Oldenburg B, O'Neal H, Shephard RJ. Worksite physical activity interventions. *Am J Prev Med* 1998;15:344–61.

21 Allender S, Cowburn G, Foster C. Understanding participation in sport and physical activity among children and adults: a review of qualitative studies. *Health Educ Res* 2006;21:826–35.

22 Titze S, Stronegger W. [German-language reconstruction of the processes of behavior change according to the trans-theoretical model in participants of women's fun run]. *Soz Praventivmed* 2002;47:251–61. Deutschsprachige Rekonstruktion der Strategien der Verhaltensanderung nach dem Transtheoretischen Modell—analysiert bei Teilnehmerinnen eines Frauenlaufs.

23 Marcus BH, Simkin LR. The stages of exercise behavior. *J Sports Med Phys Fitness* 1993;33:83–8.

24 Hollmann W, Hettinger T, editors. Sportmedizin Arbeits- und Trainingsgrundlagen. Schattauer, 1990, http://www.lsweb.ch/fileadmin/lsweb-dateien/publikationen/Seniorensport_SportCH2000.pdf.

25 Frey I, Berg A, Grathwohl D, Keul J. [Freiburg Questionnaire of physical activity—development, evaluation and application]. *Soz Praventivmed* 1999;44:55–64. Freiburger Fragebogen zur korperlichen Aktivitat—Entwicklung, Prufung und Anwendung.

26 Ainsworth BE, Haskell WL, Whitt MC, et al. Compendium of physical activities: an update of activity codes and MET intensities. *Med Sci Sports Exerc* 2000;32(9 Suppl.):S498–504.

27 Asikainen TM, Kukkonen-Harjula K, Miilunpalo S. Exercise for health for early postmenopausal women: a systematic review of randomised controlled trials. *Sports Med* 2004;34:753–78.

28 Asikainen TM, Miilunpalo S, Oja P, et al. Randomised, controlled walking trials in postmenopausal women: the minimum dose to improve aerobic fitness? *Br J Sports Med* 2002;36:189–94.

29 Asikainen TM, Miilunpalo S, Oja P, et al. Walking trials in postmenopausal women: effect of one vs two daily bouts on aerobic fitness. *Scand J Med Sci Sports* 2002;12: 99–105.

30 Brooke-Wavell K, Jones PR, Hardman AE. Brisk walking reduces calcaneal bone loss in post-menopausal women. *Clin Sci (Lond)* 1997;92:75–80.

31 Hamdorf PA, Withers RT, Penhall RK, Haslam MV. Physical training effects on the fitness and habitual activity patterns of elderly women. *Arch Phys Med Rehabil* 1992; 73:603–8.

32 Ready AE, Naimark B, Ducas J, et al. Influence of walking volume on health benefits in women post-menopause. *Med Sci Sports Exerc* 1996;28:1097–105.

33 Stefanick ML, Mackey S, Sheehan M, et al. Effects of diet and exercise in men and postmenopausal women with low levels of HDL cholesterol and high levels of LDL cholesterol. *N Engl J Med* 1998;339:12–20.

34 Busby J, Notelovitz M, Putney K, Grow T. Exercise, high-density lipoprotein-cholesterol, and cardiorespiratory function in climacteric women. *South Med J* 1985;78:769–73.

35 Foster C, Hillsdon M, Thorogood M. Intervention for promoting physical activity. *Cochrane Database Syst Rev [Internet]* 2005;1:CD003180.

36 King AC, Haskell WL, Taylor CB, et al. Group- vs home-based exercise training in healthy older men and women. A community-based clinical trial. *JAMA* 1991;266: 1535–42.

37 Calfas KJ, Sallis JF, Nichols JF, et al. Project GRAD: two-year outcomes of a randomized controlled physical activity intervention among young adults. *Am J Prev Med* 2000;18:28–37.

38 Lamb SE, Bartlett HP, Ashley A, Bird W. Can lay-led walking programmes increase physical activity in middle aged adults? A randomised controlled trial. *J Epidemiol Community Health* 2002;56:246–52.

39 Kahn EB, Ramsey LT, Brownson RC, et al. The effectiveness of interventions to increase physical activity. A systematic review. *Am J Prev Med* 2002; 22(4 Suppl.):73–107.

40 Andre N, Dishman RK. Evidence for the construct validity of self-motivation as a correlate of exercise adherence in French older adults. *J Aging Phys Act* 2012;20: 231–45.

41 Teixeira PJ, Carraca EV, Markland D, et al. Exercise, physical activity, and self-determination theory: a systematic review. *Int J Behav Nutr Phys Act* 2012;9:78.

42 Wallace BA, Cumming RG. Systematic review of randomized trials of the effect of exercise on bone mass in pre- and postmenopausal women. *Calcif Tissue Int* 2000; 67:10–8.

43 Dishman RK. Compliance/adherence in health-related exercise. *Health Psychol* 1982; 1:237–67.

44 Martin JE, Dubbert PM. Adherence to exercise. *Exerc Sport Sci Rev* 1985;13:137–67.